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On the interconfigurational $4f^25d$–$4f^3$ VUV and UV fluorescence features of Nd^{3+} in $LiYF_4$ (YLF) single crystals under F_2 laser pumping

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Fluorescence spectra and kinetics of $LiYF_4(YLF):Nd^{3+}$ single crystals pumped by an F_2 pulsed discharge molecular laser at 157 nm have been obtained in the VUV and UV regions of the spectrum between 150–300 nm. With this pumping scheme some new fluorescence peaks have been observed. The high photochemical stability of this material under the above pumping scheme suggests that it can be used as an active medium for VUV tunable laser sources.

1. Introduction

Recently, there has been increased interest in generating coherent VUV radiation for a variety of applications, ranging from spectroscopy to photolithography [1,2]. The most attractive idea in this direction is the generation of tunable VUV laser radiation from solid state laser sources due to their simplicity in comparison to the existing nonlinear methods [3,4] in gases and vapours. The allowed radiative interconfigurational d–f transitions of the rare-earth (RE) ions in wide band-gap dielectric crystals [5] make these materials promising candidates for generating coherent VUV radiation. Waynant and Klein [6] were the first to construct a solid state VUV laser operating at 172 nm using the $LaF_3:Nd^{3+}$ crystal after irradiation with VUV light emitted from Kr_2^* excimer molecules pumped by an e-beam. The realization of a new pumping scheme [7] for this crystal using a pulsed discharge F_2 molecular laser [8,9] around 157 nm opens the way for the wide use of the rare-earth activated ions in dielectric crystals for efficiently generating tunable VUV radiation. Therefore the search for new (RE) activated wide band gap dielectric crystals as potential active medium for solid state tunable VUV lasers is of great importance.

In this paper we report on some features of the interconfigurational $4f^25d$–$4f^3$ VUV fluorescence spectrum and kinetics of $LiYF_4(YLF):Nd^{3+}$ (YLF:Nd) crystals under irradiation with laser light at 157 nm from an F_2 pulsed discharge molecular laser. Some new peaks have been observed for the first time and the possibility of using this material for generating VUV and UV laser radiation is discussed. The observed high photochemical stability of this material under F_2 laser pumping suggests that it can be used as an active medium for VUV tunable lasers.

2. Experimental

We used for this study YLF:Nd crystals specially grown by us from carbon crucibles using the Bridg-

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